22-4-2008

Advanced location-based services

Miguel A. Labrador
University of South Florida

Katina Michael
University of Wollongong, katina@uow.edu.au

Axel Kuepper
Ludwig Maximilian University

Advanced location-based services

Abstract

This special issue of Computer Communications presents state-of-the-art research and applications in the area of location-based services (LBS). Initial location-based services entered the market around the turn of the millennium and for the greater part appeared in the form of restaurant finders and tourist guides, which never gained widespread user acceptance. The reasons for this were numerous and ranged from inaccurate localization mechanisms like Cell-ID, little creativity in the design and functions of such services, to a generally low acceptance of data services. However, in recent years, there has been an increasing market penetration of GPS-capable mobile phones and devices, which not only support high-accuracy positioning, but also allow for the execution of sophisticated location-based applications due to fast mobile data services, remarkable computational power and high-resolution color displays. Furthermore, the popularity of these devices is accompanied by the emergence of new players in the LBS market, which offer real-time mapping, points-of-interest content, navigation support, and supplementary services. LBS have also received a significant boost by federal government agency mandates in emergency services, such as in the United States of America.

Keywords

Location-based services, global positioning systems, cellular, mobile data

Disciplines

Physical Sciences and Mathematics

Publication Details

Labrador, M., Michael, K. & Kupper, A. (2008). Advanced location-based services. Computer Communications, 31 (6), 1053-1054.

Advanced location-based services

This special issue of Computer Communications presents state-of-the-art research and applications in the area of location-based services (LBS). Initial location-based services entered the market around the turn of the millennium and for the greater part appeared in the form of restaurant finders and tourist guides, which never gained widespread user acceptance. The reasons for this were numerous and ranged from inaccurate localization mechanisms like Cell-ID, little creativity in the design and functions of such services, to a generally low acceptance of data services. However, in recent years, there has been an increasing market penetration of GPS-capable mobile phones and devices, which not only support high-accuracy positioning, but also allow for the execution of sophisticated location-based applications due to fast mobile data services, remarkable computational power and high-resolution color displays. Furthermore, the popularity of these devices is accompanied by the emergence of new players in the LBS market, which offer real-time mapping, points-of-interest content, navigation support, and supplementary services. LBS have also received a significant boost by federal government agency mandates in emergency services, such as in the United States of America. All these advancements are making LBS one of the most exciting areas of research and development with the potential to become one of the most pervasive and convenient services in the near future. As it turns out, these developments lead to new and sophisticated LBSs, which are referred to as ‘‘Advanced LBSs” in this special issue. Examples include, but are not limited to, proactive services, which automatically inform their users when they enter or leave the bounds of pre-de- fined points of interest; community services, where members of a community mutually exchange their locations either on request or in a proactive fashion; or mobile gaming, where the geographic locations of the players become an integral part of the game. However, the realization of such Advanced LBSs is also associated with some challenges and problems, which have yet to be resolved. For example, there is a strong need for powerful middleware frameworks, architectures and protocols that support the acquisition of location data, their distribution, and processing. In the area of localization mechanisms, accuracy, reliability, and coverage of available technologies must be improved, for example, by combining several methods and enabling a seamless positioning handover between outdoor and indoor technologies. And, finally, because LBSs will significantly change the way people interact and communicate with each other, similar to the impact that mobile phones had a decade ago, solutions must be developed that allow an LBS user to safeguard their privacy with respect to real-time location reckoning, and historical location profiles. In this special issue, we have addressed the challenges of Advanced LBSs. We received many high-quality submissions from all over the world and finally selected 13 articles. Papers were carefully reviewed and selected based on their scholarship and to provide as broad an appeal to a range of research topics. We received several papers with advanced and very interesting applications, of which we selected the most relevant and novel. Five papers are devoted to middleware and architectures, which are meant to make the infrastructure transparent to application developers and therefore speed up the development process. We received many submissions related to localization schemes and algorithms showing the importance of this aspect on location based services and the maturity of this research topic. Three localization-related papers are included in the issue. Finally, although security, privacy

and ethical issues are well-known concerns in the field of LBS, too few articles were submitted on these topics, indicating that this area requires much needed exploration. However, three interesting papers are included for your perusal. It therefore follows that advanced location-based services can be considered in totality of a given end-to-end offering or 'advanced' in a given aspect-complex network architecture, novel application, or multi-mode end-user IP device. A summary of the accepted papers follows. Two papers are related to LBS applications. The first paper, ''Location-Based Services for Elderly and Disabled People" by Alvaro Marco et al. includes a robust, low cost, highly accurate and scalable ZigBee- and ultrasound-based positioning system that provides alarm, monitoring, navigation and leisure services to the elderly and disable people in a residence located in Zaragoza, Spain. The paper ''BlueBot: Asset Tracking via Robotic Location Crawling" by Abhishek Patil et al. presents a robot-based system that combines RFID and Wi-Fi positioning technology to automatically survey assets in a facility. The proposed system, which uses off-the-shelf components, promises to automate the tedious inventory process taking place in libraries, manufactures, distributors, and retailers of consumer goods. Five of the selected papers deal with software middleware, architectures and APIs for advanced LBSs. The first paper, ''The PoSIM Middleware for Translucent and Context- aware Integrated Management of Heterogeneous Positioning Systems" by Paolo Bellavista et al., presents middleware that integrates and hides different positioning systems to the application developer while providing different levels of information depending on context, LBS requirements, user preferences, device characteristics, and overall system state. PoSIM provides application developers both, a high level APIs that provides simplified access to positioning systems, and a low level API that provides detailed information from a specific positioning system. Sean Barbeau et al. present an update of the under-development JSR293 Java Location API for J2ME. The article describes the main features of the current API as well as the significant enhancements and new services included in the standardization effort of the expert group so far. Next, the paper ''The Internet Location Services Model" byMartin Dawson presents the architecture and services being standardized by the IETF to provide location information to devices independently of any remote service provider. Hasari Celebi and Hu¨seyin Arslan in ''Enabling Location and Environment Awareness in Cognitive Radios" propose a cognitive radio-based architecture that utilizes not only location but also environment information to support advanced LBS. Finally, Christo Laoudias et al. present ''Part One: The Statistical Terminal Assisted Mobile Positioning Methodology and Architecture". The paper describes the architecture of the STAMP system, which is meant to improve the accuracy of existing positioning systems by exploiting measurements collected at the mobile terminal side. In the area of localization, three papers are included for your perusal. The first paper by Yannis Markoulidakis et al. present ''Part Two: Kalman Filtering Options for Error Minimization in Statistical Terminal Assisted Mobile Positioning", a Kalman filter-based solution to minimize the terminal position error for the STAMP system. Then, Marian Mohr et al. present ''A Study of LBS Accuracy in the UK and a Novel Approach to Inferring the Positioning Technology Employed", an empirical study of the accuracy of positioning information in the UK and a novel technique to infer the positioning technology used by the cellular operators. Finally, in ''MLDS: A Flexible Location Directory Service for Tiered Sensor Networks", Sangeeta Bhattacharya et al. present a multi-resolution location directory service that allows the

realization of LBSs with wireless sensor networks. The system successfully tracks mobile agents across single and multiple sensor networks while considering accuracy and communication costs. The final three articles are devoted to security, privacy and ethical issues, again, very important topics in the realization of advanced LBSs. In ''Location Constraints in Digital Rights Management", Adam Muhlbauer et al. describe the design and implementation of a system for creating and enforcing licences containing location constraints, which can be used to confine access to sensitive documents to a defined area. The following paper, ''A TTP-Free Protocol for Location Privacy in Location-Based Services" by Agusti Solanas and Antoni Martı´nez-Balleste´, presents a distributed technique to progressively increase the privacy of the users when they exchange location information among untrusted parties. Finally, the paper ''A Research Note on Ethics in the Emerging Age of Überveillance" by M.G. Michael et al. defines, describes and interprets the socio-ethical implications that tracking and monitoring services bring to humans because of the ability of the government and service providers to collect targeted data and conduct general surveillance on individuals. The study calls for further research to create legislation, policies and social awareness in the age of Überveillance, an emerging concept used to describe exaggerated, omnipresent electronic surveillance. This issue of Computer Communications offers a ground-breaking view into current and future developments in Advanced Location-Based Services. The global nature of submissions indicates that location-based services is a world-wide application focus that has universal appeal both in terms of research and commercialization. This issue offers both academic and industry appeal- the former as a basis toward future research directions, and the latter toward viable commercial LBS implementations. Advanced location-based services in the longer-term will be characterized by their criticalness in consumer, business and government applications in the areas of banking, health, supply chain management, emergency services, and national security. We thank Editor-in-Chief Jeremy Thompson and Co- Editor-in-Chief Mohammed Atiquzzaman for hosting this special issue. Thanks also to Lorraine McMorrow and Sandra Korver for their support overseeing the paper review and publishing processes. We also thank all the authors and anonymous reviewers for their hard and timely work. We hope you enjoy this issue as much as we did!

Guest Editors
Miguel A. Labrador
Katina Michael
Axel Küpper
Available online 26 January 2008